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- US5479210 (A1)
- JP7170489 (A)
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Abstract not available for GB2278973
Abstract of corresponding document: **EP0629090**

A video image processing system comprises an input cache store (3) for temporarily storing input video data, compressors (13, 15) for compressing image data from the input store and an output store (17) comprising multiple storage areas (19) of known fixed size for storing respective files of compressed data from the compressors (13, 15). The compressors are arranged to compress each image of the input video data to a given initial degree to produce respective data files. A processor (16) compares the number of bytes in each data file with the known size of one storage area (19) in the output store (17) to determine whether the data file will occupy a predetermined proportion of said storage area. In the event that the data file will not occupy said predetermined portion of said storage area, the processor causes one of the compressors to effect one or more repeat compressions to a different degree in order to produce a data file of a size which will occupy said predetermined proportion of said storage. The system thereby optimises the compression of data and the utilisation of storage in the storing of the compressed data.

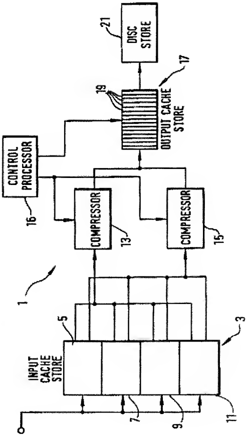


FIG. 1

Data supplied from the ***esp@cenet*** database - Worldwide

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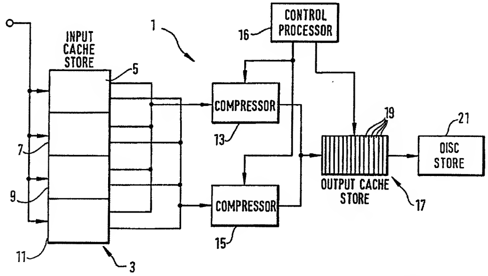
(54) **Compressing video images to a predetermined size**

(57) An input cache store 3 for temporarily storing input video data is connected to compressors 13, 15 for compressing image data from the input store and an output store 17 comprising multiple storage areas 19 of known fixed size for storing respective files of compressed data from the compressors 13, 15. The compressors compress each image of the input video data to a given initial degree to produce respective data files. A processor 16 compares the number of bytes in each data file with the known size of one storage area 19 to determine whether the data file will occupy a predetermined proportion of the storage area. If the data file will not occupy said predetermined portion of the storage area, the processor causes one of the compressors to effect one or more repeat compressions to a different degree in order to produce a data file of a size which will occupy said predetermined proportion of the storage. The system thereby optimises the compression of video data.

*FIG. 1*




At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

This print takes account of replacement documents submitted after the date of filing to enable the application to comply with the formal requirements of the Patents Rules 1990.

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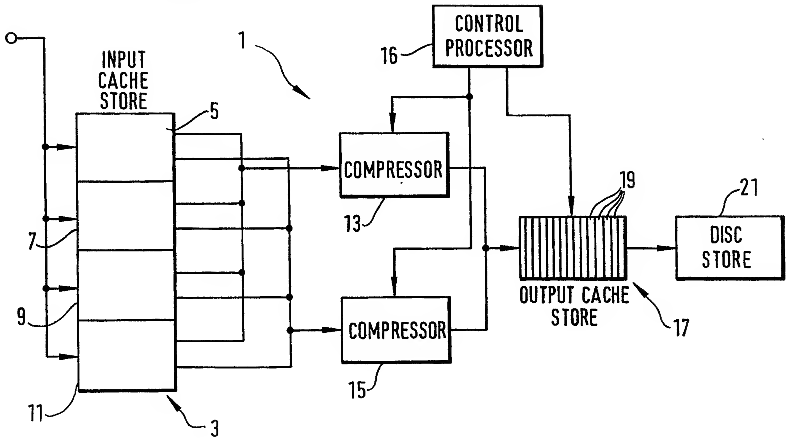
FIG. 1


INPUT CACHE STORE
CONTROL PROCESSOR
COMPRESSOR
COMPRESSOR
OUTPUT CACHE STORE
DISC STORE
1
3
5
7
9
11
13
15
16
17
19
21

# VIDEO IMAGE PROCESSING SYSTEMS

This invention relates to video image processing systems.

It is desirable that such systems in which there is storage of image sequences should be operated with a fixed file size, that is to say, with a store in which equal capacity is allocated for storage of each image of the sequence. Where the stored images are uncompressed, as is normally the case in on-line systems, such a store is the natural form to be adopted. However, the use of this type of store in systems, such as off-line systems, where the stored images are compressed, presents difficulties.

Because the compression achieved in an image employing a given compression factor is substantially less for a complex image than it is for a simple image, the compressed complex image contains more data than the compressed simple image.

Further, for a given image, the greater the applied compression factor, the more compressed is the resultant image and the smaller therefore is the required file size so that for a particular compression factor, if the image is a simple image it will require a smaller storage capacity than would be the case if the image were a complex image. Accordingly, for a sequence of images for example of moving video a range of different file sizes would be called for to

store the sequence.

The use of a store having different file sizes is an unattractive option because a uniform file size store considerably simplifies the filing structure of a machine where the permanent store is a disc store for which random access is provided and which can record to and delete from the store individual images of video. The use of a fixed file store also maintains the family similarity with machines in which the stored images are not compressed.

If a variable file size for image storage is ruled out, the obvious course is to use a sufficiently high compression factor so that almost any image, notwithstanding its complexity will compress into the requisite file size. However, this inevitably means that a higher compression factor than necessary will be used on most images resulting in a lower than necessary image replay quality.

This implies the need to employ a variable compression factor to achieve equalisation of the data content for each of the compressed images of the sequence being stored.

It is an object of the present invention, therefore, to afford an improved video image processing system in which images of an input image sequence are stored after compression.

The present invention consists in a video image processing system comprising a video image input means

for the supply in digital data form of a sequence of video images, video image storage means adapted to store in sequence the images supplied from said input means, data compression means for compressing in sequence the data of the images supplied to the storage means at a speed faster than the speed of the supply of images to the storage means, variable control means for varying the degree of compression effected by the compression means, further storage means for storing images operated on by the compression means and having the same sized storage capacity allocated for storage of each image supplied thereto from the compression means, and processor means for determining if the data of each image supplied to the further storage means occupies a predetermined proportion of the capacity thereof allocated for each image and for activating the control means to adjust the degree of compression effected by the compression means to a value employed in a repeat compression of the image which enables storage thereof in said predetermined proportion of the capacity allocated to that image in the further storage means.

Advantageously, the compression means are adapted to apply to the images of the sequence supplied thereto an initial degree of compression equal to that applied to the previous image which compressed that image to enable storage thereof in the further storage

means.

Preferably, the processor means are adapted to enable the compression means to effect a plurality of repeat compressions at respective different degrees of compression of the data of each image until the image is compressed to an extent which enables storage thereof in the predetermined proportion of the capacity allocated to it of the further storage means.

Suitably, the compression means are adapted to operate at a speed higher than that of real time operation to enable one or more repeat compressions of each image whilst maintaining real time operation.

Advantageously, the compression means comprise respective uncompressed and compressed cache stores to allow one or more repeat compressions of each image whilst maintaining real time operation.

In one form of the invention, the compression means comprise first and second compression means which cooperate to enable at least one repeat compression prior to storage in said further storage means of each image whilst real time operation is maintained.

According to a preferred feature of the invention, the processor means determines the degree of compression required for repeat compression of an image by means of a predictive algorithm.

Preferably, said algorithm is a function of the degree of compression of the image applied to the

image in the compression preceding the repeat, the quantum of occupancy of the capacity of the further storage means allocated to the image compressed in the compression preceding the repeat and the desired occupancy by the image of said allocated capacity of the further storage means.

Suitably, the predictive algorithm is given by

$$Q' = Q\left(\frac{\text{storage needed}}{\text{storage wanted}}\right)^{\alpha}$$

where $Q$ = the compression required for a repeat compression of the image,

$Q$ = the compression of the image preceding the repeat compression,

$\alpha$ = is an empirically determined constant,

the "storage needed" is the storage capacity of the further storage means which would be required to store the image as compressed by the compression preceding the repeat, and the "storage wanted" is the proportion of the storage capacity allocated in the further storage means for each image which it is desired to fill by the compressed image.

The invention will now be described, by way of example with reference to the accompanying drawing which illustrates elements of a video processing system in which storage of a sequence of compressed video images takes place.

Referring to the drawing, in a video processing system 1 a sequence of fields of video, suitably, moving video, in which each field comprises digital data, is supplied to a cache storage means 3 in which the fields are stored in separate field store areas 5, 7, 9, 11 the number of which depends on the number of repeat compression of each field that the system is required to provide for. Pairs of successive fields comprise respective frames of the video sequence. The video input can randomly access the field store areas.

Two compressors 13 and 15 are provided each of which can randomly access each field store area and effect compression of an accessed field at a speed greater than that at which the fields are supplied to the storage means 3.

The compressed fields from the compressors are supplied under the control of a processor 16 to a compressed cache store 17 having file stores 19 for storing respective compressed fields, the file stores being of equal capacity. The store 17 under the control of the processor 16 supplies images contained in the file stores 19 to a disk store 21 or other form of permanent storage, for example; a video tape recorder.

The initial compression factor applied to each of the fields of the sequence is equal to that which was employed with the preceding field to achieve the compression thereof at which it was loaded into its

file 19.

The processor 16 whilst a file 19 is being loaded with a compressed field from one or other of the compressors counts the number of bytes of data of the field concerned and if that number is above or below predetermined limits, the processor will instruct the relevant compressor 13 or 15 to alter the degree of compression effected thereby according to a predictive algorithm, one suitable algorithm being as follows:

$$Q' = Q\left(\frac{\text{storage needed}}{\text{storage wanted}}\right)^{\alpha}$$

where $Q'$ = the compression required for a repeat compression of the image,

$Q$ = the compression of the image preceding the repeat compression,

$\alpha$ = is an empirically determined constant a suitable value of which being 1.33,

the "storage needed" is the storage capacity of the file store 19 being loaded needed to store the image as compressed by the compression preceding the repeat, and

the "storage wanted" is a predetermined proportion of the capacity of the file store 19 being loaded which it is desired to fill by the compressed image.

Accordingly, the repeat compression, if required, is carried out under a degree of compression calculated from the value of the compression preceding

the repeat multiplied by a factor which comprises a ratio of the number of bytes counted by the processor divided by the number of bytes equivalent to a predetermined proportion of the capacity of the file which it is desired to fill, such ratio being raised to the power of an empirically determined constant.

In some circumstances for example where the compressed field occurs at a cut, more than one repeat compression of one or more of the fields of the sequence may be needed to achieve satisfactory utilisation of the file size into which the field is being loaded. In such circumstances value of Q for the second or subsequent compression is the degree of compression applied to the field in the compression preceding the second or subsequent repeat.

If the retry limit of the system is reached, a default value of Q is employed which guarantees that the compressed image will fit into the predetermined proportion of the file allocated for the purpose.

It will be apparent that a single compressor rather than the two illustrated may be employed. However, the need to repeat compressions loses time and may cause the compression hardware to fail to keep up with the speed of supply, which may be in real time, of fields to the field store areas of cache store 3. The provision of large cache stores 3 and 17 helps but when a single compressor is employed, the system will only cope with occasional repeats. The

employment of two compressors allows a second repeat compression for every field though, because of the success of the predictive algorithm, this does not actually often happen. The system illustrated allows easily for occasional multiple repeat compressions.

The manner of operation of the two compressors is as follows; as the loading of first field of the first frame of the sequence into field store area 5 is completed, loading of the second field commences into area 7 during which compression of the first field by compressor 13 commences at a speed which is somewhat higher than that of the supply of fields of the sequence to the store 3. If the degree of compression imparted to the first field is such that the number of bytes of the compressed image is between the predetermined limits, i.e. those which will give satisfactory occupation of the file being filled, the compression of the second field takes place by compressor 12 whilst loading into area 9 of storage means 3 of the third field takes place. By virtue of its speed being greater than that of the supply of fields to storage means 3, compressor 13 is available, so long as no repeat compressions are needed, to handle the field compressions required. Suppose, however, each field needs a repeat compression before its data content can satisfactorily occupy the file of store 17 allocated to it, what happens is that the first field is supplied to store area 5 and

compression thereof is effected by compressor 13 whilst the second field is loaded into store area 7. As the speed of the compressors exceeds that of the supply of fields to the store 3, the repeat compression of the first field can be handled by compressor 13 whilst the first compression of the second field is handled by compressor 15 whilst the third field is loaded into area 9 of store 3. The repeat compression of field 2 is handled by compressor 15 whilst the first compression of field 3 is effected by compressor 13 which is available since the repeat compression of the first field was accepted by store 17. Accordingly, the fields supplied to the store 3 are effectively in a queue and the compressions and repeat compressions of the fields are handled by the compressor which is available at the time a compression or repeat compression is required to be effected.

It will be appreciated that the system operates so that the amount of image data loaded into each file of the store tends to be equalised with the result that the average quality of replay is improved compared with the case where the compression factor applied is fixed and chosen to accommodate the most complex image and has the appearance of uniformity.

During replay the image decompressor must be set up to match the compression factor which was used to compress the image file it is about to decompress.

Accordingly, this can be achieved by this compression factor in a header attached to the front of each compressed file on the disc store 21.

**CLAIMS**:

1. A video image processing system comprising:

video image input means for the supply in digital data form of a sequence of video images;

video image storage means adapted to store in sequence the images supplied from said input means;

data compression means for compressing in sequence the data of the images supplied to the storage means at a speed faster than the speed of the supply of images to the storage means;

variable control means for varying the degree of compression effected by the compression means;

further storage means for storing images operated on by the compression means and having the same sized storage capacity allocated for storage of each image supplied thereto from the compression means; and

processor means for determining if the data of each image supplied to the further storage means occupies a predetermined proportion of the capacity thereof allocated for each image and for activating the control means to adjust the degree of compression effected by the compression means to a value employed in a repeat compression of the image which enables storage thereof in said predetermined proportion of the capacity allocated to that image in the further storage means.

2. A video image processing system claimed in claim 1, characterised in that the compression means are adapted

to apply to the images of the sequence supplied thereto an initial degree of compression equal to that applied to the previous image which compressed that image to enable storage thereof in the further storage means.

3. A video image storage means as claimed in claim 1 or claim 2, characterised in that the processor means are adapted to enable the compression means to effect a plurality of repeat compressions at respective different degrees of compression of the data of each image until the image is compressed to an extent which enables storage thereof in the predetermined proportion of the capacity allocated to it of the further storage means.

4. A video image processing system as claimed in claim 3, characterised in that said compression means are adapted to operate at a speed higher than that of real time operation to enable one or more repeat compressions of each image whilst maintaining real time operation.

5. A video image processing system as claimed in claim 4, characterised in that said storage and further storage means comprise respective uncompressed and compressed cache stores to allow one or more repeat compressions of each image whilst maintaining real time operation.

6. A video image processing system as claimed in any

preceding claim, characterised in that said compression means comprise first and second compression means which cooperate to enable at least one repeat compression prior to storage in said further storage means of each image whilst real time operation is maintained.

7. A video image processing system as claimed in any preceding claim, characterised in that the processor means determines the degree of compression required for repeat compression of an image by means of a predictive algorithm.

8. A video image processing system as claimed in claim 7 characterised in that said algorithm is a function of the degree of compression of the image applied to the image in the compression preceding the repeat, the quantum of occupancy of the capacity of the further storage means allocated to the image compressed in the compression preceding the repeat and the desired occupancy by the image of said allocated capacity of the further storage means.

9. A video image processing system as claimed in claim 7 or claim 8, characterised in that the predictive algorithm is given

by $$Q' = Q\left(\frac{\text{storage needed}}{\text{storage wanted}}\right)^{\alpha}$$

where $Q$ = the compression required for a repeat compression of the image,

Q = the compression of the image preceding the repeat compression,

$\alpha$ = is an empirically determined constant,

the "storage needed" is the storage capacity of the further storage means which would be required to store the image as compressed by the compression preceding the repeat, and the "storage wanted" is the proportion of the storage capacity allocated in the further storage means for each image which it is desired to fill by the compressed image.

10. A video image processing system as claimed in any preceding claim, characterised in that the sequences of images stored in the storage means and compressed by the compression means comprise successive fields of video frames.

11. A video processing system as claimed in any preceding claim, characterised in that the image sequence supplied to the video storage means comprises moving video.

12. A video image processing system in which video data representing a sequence of video images is processed for storage in a compressed form, the system being arranged to compress the data for incoming video images, to examine the compressed data for each image in order to

determine whether compression is optimal and to recompress the data for an image using different compression parameters where the compression is found not to be optimal.

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|---|---|
| **Patents Act 1977**<br>**Examiner's report to the Comptroller under Section 17 (The Search Report)** -17- | Application number<br>GB 9312039.2 |
| **Relevant Technical fields**<br>(i) UK Cl (Edition L ) H4F (FRM, FRW, FRX)<br>(ii) Int Cl (Edition 5 ) H04N (1/41, 5/91, 5/92, 7/13) | Search Examiner<br>M K REES |
| **Databases** (see over)<br>(i) UK Patent Office<br>(ii) ONLINE DATABASE: WPI | Date of Search<br>24 AUGUST 1993 |

Documents considered relevant following a search in respect of claims 1 TO 12

| Category (see over) | Identity of document and relevant passages | Relevant to claim(s) |
|---|---|---|
| X | EP 0493130 A2 (CANON KK) - see Figure 1; page 5, line 18 to page 7, line 31 | 1, 7, 12 |
| X | EP 0378316 A1 (CROSFIELD ELECT.) - see abstract | 1, 12 |
| A | EP 0284161 A2 (PHILIPS) - see abstract | 1, 12 |

| Category | Identity of document and relevant passages | Relevant to claim(s) |
|---|---|---|
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